SESSION VI: RUSTS

Sources of stem rust resistance and potential for strategic deployment.

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Routine deployment of broadly effective, stem rust resistance gene combinations has not been possible, practical, and/or sufficiently emphasized in most wheat breeding programs throughout the world in recent decades. Stem rust races in the Ug99 lineage demand an exhaustive and strategic effort to disrupt this cycle and incline the balance of this ancient battle towards wheat resistance. The current global emphasis and investments in stem rust pathology, germplasm enhancement, dissection of resistance genetics, and breeding will provide the necessary information and materials to adequately address the stem rust threat over the next 20+ years of wheat breeding and on-farm production. The exploitation of perfect markers for durable resistance loci, nonhost resistance mechanisms, and/or novel biotech solutions will most likely predominate in the long term. The most obvious limitations to achieving durable stem rust resistance in the short to medium term are 1) the pace of variety development and replacement in winter wheat breeding and 2) insufficient community coordination and commitment to gene deployment.

In addition to 'new' genes resulting from ongoing discovery and germplasm enhancement efforts, seedling resistance genes *Sr22*, *Sr25*, *Sr26*, *Sr32*, *Sr35*, *Sr39*, *Sr40*, *Sr42*, *Sr1A·1R*, *SrTmp*, *SrA*, *SrB*, *SrC*, *SrACCadillac*, and *SrR* should be on the radar of hard winter wheat breeders. The durable resistance locus *Sr2* should be considered in every gene-deployment strategy/pyramiding effort. Durable rust resistance locus *Lr34*/*Yr18* also is associated with stem rust adult-plant resistance, at least in the Thatcher background, and represents another likely component of gene pyramids. Introgression of uncharacterized adult-plant resistance in hard winter wheat is underway, and molecular markers should enable this effort, in spite of screening limitations in East Africa.

Stripe rust resistance in hard winter wheat.

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Stripe rust resistance data for the 2009 hard winter wheat Regional Germplasm Observation Nursery (RGON, n = 261) were reported by researchers in Manhattan, KS, and Raleigh, NC, from field nurseries or greenhouse seedling tests. Adult-stage field infection type (IT) and percent severity data from KS and NC were well correlated within and between sites ($r = 0.65$-0.88, $P < 0.0001$). The distribution of mean field adult-stage infection type (0–9 scale) over both locations was strongly skewed toward resistance. The percentages of resistant (IT = 0–3), intermediate (IT = 4–6), and susceptible (IT = 7–9) lines were 70%, 20%, and 10%, respectively. On the other hand, greenhouse seedling ITs were strongly skewed toward susceptibility. The percentages of resistant, intermediate, and susceptible lines at the seedling stage were 2%, 25%, and 73%, respectively. Therefore, the majority of effective resistance in the RGON lines is adult-plant resistance (APR). Some lines had an intermediate ITs but high disease severity, which was associated with a necrotic stripe reaction. For the 2009 Northern and Southern Regional Performance Nurseries (NRPN, n = 25; SRPN, n = 46), field and greenhouse data were available from KS, NC, and three locations in WA. Data for the NRPN and SRPN were combined for analysis. Adult-stage IT and severity data were again well correlated within and between KS and NC ($r = 0.50$–0.75, $P < 0.0001$). IT and severity data from KS and NC were correlated with severity, but not IT from Pullman, WA ($r = 0.35$-0.47, $P < 0.01$), but were practically uncorrelated with data from Mt. Vernon or Walla Walla, WA. The percentage resistance in the NRPN+SRPN based on mean adult-stage infection type over three locations was 61% resistant, 31% intermediate, and 8% susceptible. At the seedling stage, 0% were resistant, 25% intermediate, and 75% susceptible, thus again showing the prevalence of APR. Thirty-eight percent of lines were positive for the VENTRIUP-LN2 marker for the *Ae. ventricosa* chromosome segment carrying *Yr17*. Lines with the marker had average adult-stage field severities of 10%, whereas lines without the marker had average severities of 33%.